When do you step up or increase long-term control medications?

To regain control when the child has:

- Increased symptoms and/or nighttime awakenings due to symptoms.
- Reduced ability to play, exercise, or participate in normal daily activities.
- Daily or increasing use of short-acting beta$_2$-agonists.
- Reduction in PEF (by about 20%).
- When the goals of therapy are not being achieved.

How to help the child regain control of asthma:

- A short (3- to 10-day) course of oral corticosteroids may be needed to speed the resolution of moderate or severe exacerbations, or to reestablish control during a period of gradually deteriorating symptoms.
- If a short course of oral corticosteroids does not control symptoms, is effective for only a short time (i.e., < 2 weeks), or if the child used oral corticosteroids frequently, consider a step-up or increase in the long-term control medication. This can be achieved by:
  - ⇒ Increasing the dose.
  - ⇒ Increasing the frequency of dosing.
  - ⇒ Using or adding a different medication.

Before increasing medications, assess possible reasons for poor asthma control:

- Inhaler technique
- Adherence
- Environmental exposures
- Complicating factors (e.g., upper respiratory infections)

Remember the goals of therapy:

- Prevent chronic and troublesome symptoms.
- Prevent exacerbations of symptoms.
  - ⇒ No acute episodes of asthma that require a doctor visit, emergency room visit, or hospital stay.
- Maintain normal activity levels.
- Maintain “normal” pulmonary function.
- Minimal (ideally no) adverse effects from medication.

Children with severe persistent asthma may need to use oral corticosteroids on a long-term basis.

Children with asthma whose symptoms are not controlled on high doses of inhaled corticosteroids *and* long-acting bronchodilators may need to use oral corticosteroids on a regular, long-term basis. For these children:

- Use the lowest possible dose (single dose, daily or on alternate days).
- Monitor the child closely for corticosteroid adverse effects.
- Make persistent attempts to reduce use of oral corticosteroids when control of asthma is achieved. High doses of inhaled corticosteroids are preferable because of fewer adverse effects.
- Regular consultation with an asthma specialist is recommended.

Remember when using the stepwise approach to therapy that referral to an asthma specialist for consultation or co-management is recommended when:

- The child has had a life-threatening asthma exacerbation.
- Goals of asthma therapy are not being met after 3-6 months of treatment; earlier if the child appears unresponsive to treatment.
- Signs and symptoms are atypical, or there are problems in differential diagnosis.
- Other conditions complicate asthma or its diagnosis (e.g., untreated sinusitis, rhinitis).
- Additional diagnostic testing is indicated (e.g., pulmonary function testing, allergy skin testing).
- The child or family needs additional education and guidance on complications of therapy, problems with adherence, or avoidance of triggers.
- The child is being considered for immunotherapy.
- The child has severe persistent asthma.
- The child is under 3 years of age and has moderate or severe persistent asthma.
- The child has used long-term oral corticosteroid therapy, high-dose inhaled corticosteroid therapy, or more than 2 bursts of oral corticosteroids in 12 months.

Treat asthma exacerbations promptly and aggressively.

- All children with asthma need an inhaled, short-acting beta$_2$-agonist (MDI, nebulizer, DPI) for exacerbations.
- Give the child, the child's family, and caregivers (daycare providers, teachers, coaches, scout leaders, camp counselors, school and camp nurses) a written, easy-to-understand ACTION PLAN to manage exacerbations. Include:
  - ⇒ The early signs of worsening asthma.
  - ⇒ Which medications to use and how to use them.
  - ⇒ Specific instructions for when to contact the physician or emergency room.
- A short (3- to 10-day) course of oral corticosteroids may be needed to speed the resolution of moderate persistent or severe persistent exacerbations, or to reestablish control during a period of gradually deteriorating symptoms.
- Exacerbations of asthma symptoms (coughing, wheezing, shortness of breath or rapid breathing, chest tightness) with viral respiratory infections are common in children, and need to be treated appropriately with adequate doses of short-acting beta$_2$-agonists and, in some cases, oral corticosteroids.
- Asthma exacerbations may require treatment at the physician's office or emergency room.
  - ⇒ Frequent short-acting beta$_2$-agonist, by nebulization.
  - ⇒ Consider adding ipratropium bromide.
  - ⇒ Consider oxygen to relieve hypoxemia.
  - ⇒ Pulse oximetry is recommended to follow oxygen saturation.
  - ⇒ Monitor the response to therapy with serial measurements of FEV_1 or PEF.

All children with asthma should have a short-acting bronchodilator to provide prompt relief of acute symptoms (coughing, wheezing, difficulty breathing, chest tightness).

Over-the-counter MDIs are not as effective as short-acting, inhaled beta$_2$-agonists, and may unnecessarily delay seeking medical care.

All offices that treat acute exacerbations of asthma should have a peak flow meter, a nebulizer, an oximeter, and oxygen.

Assessing the Severity of an Asthma Exacerbation

Asthma severity is a continuum. Any child, regardless of overall severity, can have a severe exacerbation.

Risk Factors for Death from Asthma

- Past history of sudden severe exacerbations
- Prior intubation for asthma
- Prior admission to intensive care unit for asthma
- ≥ 2 hospitalizations for asthma in past 12 months
- ≥ 3 emergency care visits for asthma in past 12 months
- Hospitalization or emergency care visit for asthma in past month
- Use of > 1 canister/month of inhaled short-acting $beta_2$-agonist
- Current chronic use of oral corticosteroids
- Difficulty perceiving airflow obstruction or its severity
- Low socioeconomic status and urban residence
- Illicit drug use
- Serious psychiatric disease or psychosocial problems

Look at the child for signs of distress:

- **Shortness of breath or rapid breathing**
  - ⇒ As severity increases, the child may have difficulty talking or laying down. The infant may have difficulty feeding and may have a shorter, softer cry.
- **Increased respiratory rate** (see table below)
- **Use of accessory muscles with retractions**
- **Wheezing**
  - ⇒ In mild exacerbations, wheezing is evident on expiration.
  - ⇒ As the severity of the exacerbation increases, both inspiratory and expiratory wheezing may be present.
  - ⇒ During a severe exacerbation, the chest may be "silent."
- **Decreased PEF**
- **Agitation**

Normal Breathing and Pulse Rates for Children

Age	Breathing rate (awake)	Pulse rate
< 2 months	< 60/minute	< 160/minute
2-12 months	< 50/minute	< 120/minute
12-24 months	< 40/minute	< 110/minute
2-5 years	< 40/minute	< 110/minute
6-8 years	< 30/minute	< 110/minute

Managing Asthma Exacerbations in the Home

Assess severity

Measure PEF: < 50% predicted or personal best suggests severe exacerbation.

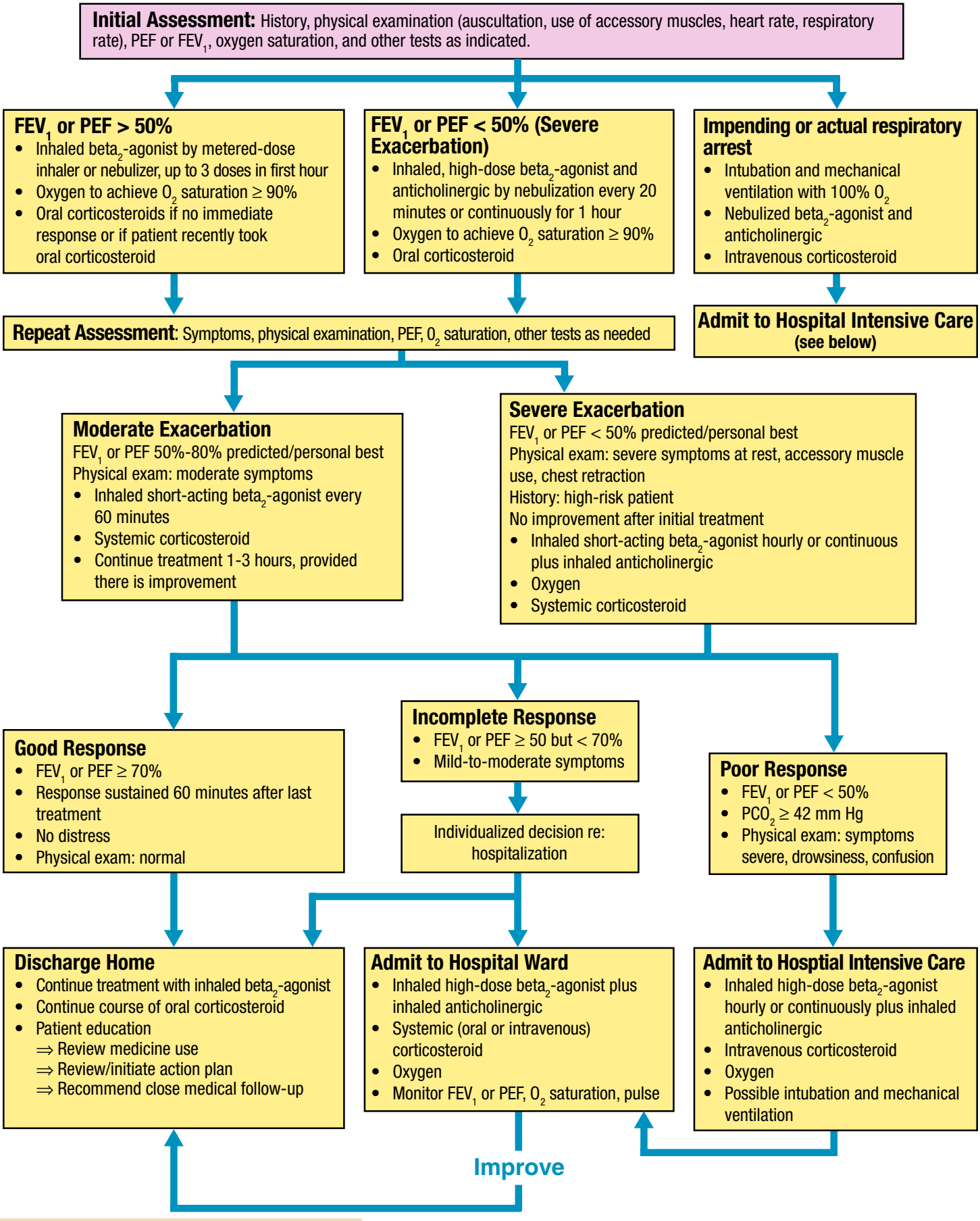
Note signs and symptoms: Degree of cough, shortness of breath, wheeze, chest tightness correlate imperfectly with severity. Accessory muscle use and retractions (sucking in of chest) suggest severe exacerbation.

Initial treatment

Inhaled short-acting $beta_2$-agonist: up to 3 Tx of 2-4 puffs by MDI every 20 min, or 1 nebulizer Tx

Repsonse to treatment	Good	Incomplete	Poor
Exacerbation **PEF (predicted or personal best)** **Wheezing or shortness of breath**	*Mild* > 80% None	*Moderate* 50%-80% Persistent	*Severe* < 50% Marked
Continued Treatment	Continue inhaled, short-acting $beta_2$-agonist every 3-4 hrs for 24-48 hrs. For children on inhaled corticosteroids, double dose for 7-10 days.	Continue inhaled short-acting $beta_2$-agonist. Add oral corticosteroid.	Repeat $beta_2$-agonist immediately. Add oral corticosteroid.
Follow-up	Contact clinician.	Contact clinician same day.	If distress is severe and child is non-responsive, CALL DOCTOR IMMEDIATELY, AND PROCEED TO EMERGENCY DEPARTMENT. CONSIDER CALLING AMBULANCE OR 911.

Management of Asthma Exacerbations: Emergency Department and Hospital-Based Care



Special Considerations when Treating Children with Asthma

Administering asthma medications to infants and children can be challenging.

- Medications to treat asthma in children may be given by inhalation or orally (as tablets or liquids).
  - ⇒ The inhaled route is generally preferred because:
    - – Higher concentrations can be delivered more effectively to the airways.
    - – Systemic side effects are avoided or minimized.
    - – The onset of action of short-acting beta$_2$-agonists is substantially shorter when inhaled.
- Dosages reaching the airway will vary considerably depending on the route of administration (and the device(s) used for inhaled medications).
- The ability of individual children to use different devices for inhaled medications may vary considerably.

How do you give medication to infants and young children?

- Use a metered dose inhaler with a spacer/ holding chamber plus face mask.
- Use a nebulizer.
- Use a liquid.

Liquid albuterol does not have as quick an onset-of-action as inhaled albuterol, a consideration for treating exacerbations.

For children < 2 years:

- Nebulizer therapy with face mask may be preferred for administering cromolyn sodium, and for short-acting beta$_2$-agonists during exacerbations.
- Short-acting beta$_2$-agonists are available as liquids, but:
  - ⇒ The onset of action is slower than when given by inhalation (approximately 30 minutes for the liquid as compared to several minutes for inhalation).
  - ⇒ Adverse effects (e.g., tremor, irritability) are more likely.
- Drugs administered by MDI may be given using a spacer/holding chamber and face mask.
  - ⇒ The dose will be variable.
  - ⇒ Inhaled corticosteroids by MDI should always be given with a spacer/holding chamber.

Tailor the delivery device to the child, taking the child's needs into consideration.

For children between 3 and 5 years:

- Inhaled medications are preferred.
- Some children can use an MDI and spacer/holding chamber.
- If the desired therapeutic effects are not achieved, or if the child cannot use an MDI with spacer/holding chamber, a nebulizer or MDI plus spacer/holding chamber with face mask may be required.

For school-age children:

- Inhaled medications are preferred.
- MDIs, DPIs, and nebulizers may be used.
- The child should be able to produce the necessary effort and coordination needed for the specific device.
- All inhaled corticosteroids by MDI should be used with a spacer/holding chamber.
- Some children carry their short-acting beta$_2$-agonist MDI without a spacer/holding chamber. This is acceptable if the child has demonstrated good technique.
- School medication policies should be known.

Types of Inhalation Devices for Asthma Medications

Device/Medications	Age[1]	Comments
Metered-dose inhaler (MDI) $Beta_2$-agonists Corticosteroids Cromolyn sodium Nedocromil sodium Anticholinergics	> 5 years (< 5 years with spacer/holding chamber and face mask for some children)	The child may have difficulty triggering a puff while inhaling. Use with a spacer/holding chamber helps.
Breath-actuated MDI $Beta_2$-agonists	> 5 years	The child may not be able to generate the necessary inspiratory flow. Device does not require the use of holding chamber or spacer.
Dry-powder inhaler (DPI) $Beta_2$-agonists Corticosteroids	> 5 years (can be used in 4 year olds, but delivery is more consistent over 5)	Some devices deliver drug more effectively than an MDI. Some devices may not work in children with low inspiratory volumes.
Nebulizer $Beta_2$-agonists Cromolyn sodium Anticholinergics	Patients of any age who cannot use an MDI with spacer/ holding chamber or with face mask.	Useful in infants and very young children, and any child with a moderate to severe asthma episode. Delivery method of choice for cromolyn sodium.

[1]These ages are suggested as guides for making clinical decisions. The clinician must use his/her judgment to tailor treatment to the specific needs and circumstances of the child and family.

Using an MDI with a spacer/holding chamber may be easier than using an MDI alone.

- Trigger 1 puff from MDI into spacer/holding chamber for each inhalation.
- Some young children may be able to use an MDI with spacer/holding chamber and face mask.
  - ⇒ If a face mask is used, allow 3 to 5 inhalations for each puff triggered from the MDI.

Advantages of using spacers and holding chambers:

- Many children have a difficult time inhaling while pressing the inhaler to trigger a puff. Simple tubes do not take care of this problem!
- Decreases oropharyngeal deposition.
- Reduces possible side effects, particularly with inhaled corticosteroids.
  - ⇒ Potential side effects of inhaled corticosteroids include oral candida (thrush), dysphonia, and reflex cough and bronchospasm (also evident with other inhaled medications).

The child's schedule and giving asthma medications

Instruct the child and parent in the appropriate use of all medications and devices. Advise the parent to share this information with ALL caregivers.

Have the child (and parent) bring and demonstrate use of their delivery devices (including inhalers, spacer/ holding chambers, face masks, nebulizers) at each office visit.

- Provide an action plan for handling exacerbations, including the clinician's recommendation regarding self-administration of medication and plans to ensure prompt, reliable access to medications.
- If possible, schedule long-term control medications so that they are not taken at school, even if this results in uneven dosing intervals.
  - ⇒ However, some children benefit from close supervision of therapy. For these children, giving medication at school, under the supervision of a school health professional, is recommended.
- It may be helpful for some younger children to have a compressor-driven nebulizer available at their school or daycare facility.

Reliable, prompt access to asthma medication is essential during the day.

- The child, caregivers, teachers, school nurses, and school boards should understand this.
- Older children should be allowed to carry and self-administer quick-relief medications, with physician and parent approval.

Infants and adolescents have special needs.

0 to 18 months

- **Early management of wheezing** may alter the course of asthma later on. However, infants can be difficult to manage. Referral to a pediatric asthma specialist for consultation or co-management should be considered for children being given daily medication.

- **Carefully monitor the response to medication**.
  ⇒ Treat the wheeze for 4 to 8 weeks.
  ⇒ If there is no clear response, stop treatment.
  ⇒ Consider alternate therapy or an alternate diagnosis if the child is not: growing and developing normally, eating normally and gaining weight, or sleeping.

- **Diet is usually not a factor** for the wheezing child. (When there are reactions after ingesting food, the most common causes are milk, peanut products, soy, wheat, eggs.)

- **Reducing exposure to viral respiratory infections may be important** for the difficult-to-manage wheezer.

Many children have multiple caretakers.

All homes and caretakers should have medications, devices, and a management plan for how and when to use them.

Upper respiratory viral infections are a key precipitating factor of asthma symptoms in young children.

Primary prevention of asthma (preventing initial development) may alter its course.

- Minimize exposure to dust mites, tobacco smoke, animal dander, cockroach allergens.
  ⇒ Exposure to high levels of dust mite and tobacco smoke are associated with an increased incidence of asthma among infants.
- Prolonged breast feeding and avoiding the early introduction of allergenic foods may reduce eczema and food sensitization, but have not been shown to reduce the prevalence of asthma.

Adolescents

Special concerns of the adolescent include:

- Effects of medications on appearance (height, weight, acne), ability to exercise, menses.
- Taking medications in public.
- Peer pressure.

- LISTEN to the patient! Find out their expectations and goals.
- Find out what the adolescent is willing to do, and then work out a management plan together.
- Ask the adolescent about smoking, and exposure to tobacco smoke and possible drug use.
- Encourage exercise and physical activity. Asthma should not be an excuse for not participating in physical education or sports.
  - ⇒ Develop an asthma management plan that will allow them to participate in any activity that they wish.
  - ⇒ Make it easy to take medications before exercise.
- Consider symptoms related to hobbies and workplace exposures.
- Consider nonadherence if the teen is not doing well.

Asthma, inhaled corticosteroids, and linear growth

Poorly controlled asthma may delay growth.

- Poorly controlled asthma may delay growth.
- Growth rates are highly variable. Short-term evaluations may not predict final adult height.
- Children with asthma tend to have longer periods of reduced growth rates before puberty (males more than females).
- Some studies of the use of inhaled corticosteroids to treat asthma in children have identified growth delay; others have not. The clinical significance of the findings is unclear. Monitoring growth is recommended.
  - ⇒ For children with mild or moderate persistent asthma, medium-dose inhaled corticosteroid therapy may be associated with a possible, but not predictable, adverse effect on linear growth.
  - ⇒ For children with severe persistent asthma, use of high-doses of inhaled corticosteroids has significantly less potential for adverse growth effects than oral corticosteroids.
  - ⇒ Use of spacers will minimize local and systemic effects of inhaled corticosteroids that are delivered by MDI's.

The potential risks of inhaled corticosteroids are well balanced by their benefits.

Preventing "Anticipated" Episodes of Asthma Symptoms

When you understand and recognize the triggers of asthma symptoms for a child, it is possible to prevent or at least minimize episodes of symptoms due to "anticipated exposures" to the trigger.

For "anticipated" symptoms upon exposure to:	Treat with:
Exercise	• Short-acting, inhaled beta$_2$-agonist, cromolyn sodium, or nedocromil sodium shortly (5-30 minutes) before exercising. • Long-acting beta$_2$-agonist taken at least 30 minutes before exercising. • Regular use of a long-term controller medication may reduce the likelihood of exercise-induced symptoms.
Cold (dry) air	• Short-acting, inhaled beta$_2$-agonist, cromolyn sodium, or nedocromil sodium shortly (5-30 minutes) before going out in the cold. • Cover nose and mouth with a scarf on cold or windy days.
Allergens (e.g., animal dander, pollens)	• Cromolyn sodium or nedocromil sodium shortly (5-30 minutes) before anticipated exposure.

Managing the child with seasonal symptoms

Some children experience asthma symptoms only in relationship to certain pollens and molds. If the child has seasonal asthma on a predictable basis, long-term control medication should be:

- Started (or increased) prior to the anticipated onset of symptoms and continued through the season, and
- Gradually decreased (or stopped) after the season.

Allergen immunotherapy may be considered for children with asthma when:

- There is clear evidence of a relationship between symptoms and exposure to an unavoidable allergen to which the child is sensitive.
- Symptoms occur all year or during a major portion of the year.
- There is difficulty controlling symptoms with pharmacologic management because multiple medications are required, medications are ineffective, or medications are not accepted by the child (or parents).

Referral to a specialist for consultation or co-management is recommended for children being considered for allergy immunotherapy. Allergen immunotherapy should be administered only in an office where facilities and trained personnel are available to treat any reaction that may occur. Life threatening reactions can occur, but are rare.

Viral upper respiratory infections are a key precipitating factor of asthma symptoms in young children.

Treating asthma symptoms due to viral upper respiratory infections (URIs)

- **For mild symptoms**, a short-acting, inhaled $beta_2$-agonist (every 4 to 6 hours for 24 hours, longer with physician consult) may be sufficient to control the symptoms and to improve lung function.
- **For children with recurrent URIs**, when this therapy needs to be repeated more frequently than every 6 weeks, a seasonal increase in (or starting) long-term control therapy may be necessary.
- **For a moderate persistent or severe persistent exacerbation**, a short (3- to 10-day) course of oral corticosteroids should be considered.
- **If the child has a history of severe recurrent exacerbations with URIs,** consider initiating a short (3- to 10-day) course of oral corticosteroids at the first sign of URI.
- **Appropriate long-term control therapy during the viral season** may reduce the frequency and severity of viral-induced symptoms.

Managing exercise-induced asthma

- **Exercise-induced bronchospasm (EIB) is caused** by a loss of heat, water, or both from the airways during exercise due to hyperventilation of cool, dry air relative to the air within the lungs.
- **EIB usually begins during exercise and peaks** 5 to 10 minutes after stopping exercise.
- **Exercise may be the only trigger of asthma** for some children, particularly children with allergic rhinitis.
  ⇒ These children should be monitored regularly because EIB is often a marker of inadequate asthma management.
- **Symptoms may spontaneously resolve** within 1 hour after exercise.
- **A warm-up period** before exercise may help.
- If asthma symptoms occur regularly with usual activities or exercise, increasing (or adding) daily long-term control medications may be warranted.
- **Teachers and coaches** need to be notified that a child has exercise-induced symptoms.
  ⇒ They should be told that the child can participate in activities, but may need inhaled medication before the activity.
- **Appropriate long-term control therapy,** especially with anti-inflammatory medications, can reduce the frequency and severity of exercise-induced symptoms.

Exercise-induced symptoms should be anticipated in ALL children with asthma.

Asthma should not be an excuse from participating in physical education, sports, or exercise.

- Develop an asthma management plan that will allow the child to participate in any activity that they wish.
- Make it easy to take medications before exercise.
- If full activity is not possible, have the child participate to the extent that he/she can.

Sometimes physical education/activities DO need to be adjusted for the child with asthma. For example:

- On a severe allergy day
- On a windy day
- In extreme cold
- During and/or after a viral URI

Treatment for exercise-induced asthma:	Minutes before exercise to take medication:	May prevent symptoms for up to:
Short-acting inhaled beta$_2$-agonist (2-4 puffs)	5-30 (best taken just before exercising)	2-3 hours
Cromolyn sodium or nedocromil sodium (2-4 puffs)	5-30 (best taken just before exercising)	1-2 hours
Long-acting beta$_2$-agonist (2 puffs)	At least 30	10-12 hours

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